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## PROVISIONAL SPECIFICATION.

An Improved Process for the Fermentation of Worts which have been Rendered Antiseptic.

A communication by JEAN EFFRONT, of 72 Rue du Marais, Brussels, in the Kingdom of Belgium, Doctor.

I, WILLIAM PHILLIPS THOMPSON F.C.S., M.I.M.E., of The Agency for Foreign Patent Solicitors, 6, Lord Street, Liverpool and 6 Bank Street, Manchester, both in the County of Lancaster, 118 New Street, Birmingham in the County of Warwick and 31 High Holborn in the County of Middlesex, Civil Engineer, do hereby declare the nature of this invention to be as follows :—

The improved process for the fermentation of worts which have been rendered antiseptic, which forms the object of this invention, is characterized by the setting to work in such worts, more particularly in worts for distillery purposes, of yeast which is capable of resisting the action of the antiseptic, and of thus preserving intact its fermenting power.

Hitherto efforts have always been made to overcome the great obstacle to a superior yield of alcohol, namely the existence of ferments of disease in the worts, by eliminating them therefrom, or at least by paralysing them by the aid of certain additions of antiseptics added to the worts in proportions calculated to be more or less favourable to the desired object.

If it be true that this process of rendering the worts antiseptic has the effect of rendering them unchangeable, it is certain on the other hand that the increased yield in alcohol is not very considerable, and that these manifestations so little in accord have given rise to the most erroneous hypotheses, even to that of admitting that another cause than that of the ferments might be the cause of the inferiority in the yield of alcohol.

But it is not so, and it is indeed the disease ferments which alone obstruct the work and diminish the return, and if worts which have been rendered antiseptic do not give the expected superior yield in alcohol, probably by reason of the paralysing of the ferments, it is because it depends on a cause of a very different kind which has hitherto escaped observations made, and which merely consists in the peculiarity that the additions of antiseptics employed for the purpose of paralysing the disease ferments, paralyse at the same time the yeast or fermenting power, which they weaken, thus prejudicing the final yield, and this inconvenience is particularly felt in the case of worts for distillery purposes fermenting relatively at very high temperatures, and consequently the yield of alcohol is not appreciably greater and may even be inferior to that which is obtained if the process be carried out without the use of antiseptics. Even under the most favourable conditions all the benefit which is expected from the use of antiseptics is not obtained, that is to say from the point of view of the yield in alcohol.

Under these conditions it is evident that the solution of the problem is exclusively subordinate to a perfect working of the yeast employed in the worts which have been rendered antiseptic, and that a superior yield of alcohol will be

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invariably obtained when it is possible to employ for the fermentation a yeast prepared in such a way that its vital force, or its power of fermentation is not affected by wort rendered antiseptic to a given degree, a method of working which constitutes the characteristic of this invention, the extent of which comprises therefore in principle the use of any yeast having a property of vigour or energy. 5

As a mode of preparing the yeast with a view to carrying out this improved process of fermentation, recourse is made to the repeated and numerous experiments made by the inventor, relative to the methodical cultivation of yeast in antiseptics, by which it is possible to cause the yeast to endure considerable additions of antiseptics without affecting its fermenting power, and which therefore enables it to be brought to that state of superior vigour which is necessary for resisting the worts which have been rendered antiseptic. 10

Attention is first directed to the necessity which exists in this method of working of only setting the yeast to work on worts rendered antiseptic by the same antiseptic as that which served for the methodic cultivation of the yeast, the harmful action of the two different antiseptics in the wort explaining itself quite naturally. 15

The methodic cultivation of the yeast is based on the acclimatization of the yeast in worts in which the antiseptic additions are successively and progressively reinforced, this method enabling the yeast to be brought to endure an amount of antiseptics much superior to that which the disease ferments can resist. 20

The result is, that a yeast capable of resisting a wort rendered so highly antiseptic, will not only resist a wort less antiseptic, but will exert thereon also its fermenting power with all its energy, so that in this method of working, the improved process of fermentation is characterized by the use of yeast cultivated in worts rendered antiseptic to a superior degree to that of the wort which is to be fermented, the antiseptic degree of which may in consequence be reduced in practice to the amount of antiseptic strictly necessary for paralysing the disease ferments. 25 30

Starting from this principle it has been found that, in practice, the antiseptic degree of the last named wort for the cultivation of the yeast, must be at least double that of the wort which is to be fermented, in order to obtain a maximum yield in alcohol. The principle in question and its application are better explained by the following quantitative example: 35

Taking as an antiseptic hydrofluoric acid, salicylic acid, picric acid, formic aldehyde, nitro-cresol or even any other suitable antiseptic, it is found that a quantity of .10 to .20 grammes per litre of wort in fermentation will suffice to prevent the development in such wort of disease ferments. In order to work this wort under the rational conditions hereinbefore mentioned, a yeast must be employed which has been cultivated in wort progressively reinforced with additions of antiseptics reaching 2 (.10 to .20) or .20 to .40 grammes per litre. 40

By then employing this cultivated yeast in the quantity of .20 to .40 grammes in the fermentation of wort rendered antiseptic with .10 to .20 grammes of the corresponding antiseptic, the result of the action will correspond to that which would be obtained in working by means of a good yeast a wort which has not been rendered antiseptic, but is free from all disease ferments; in other terms a maximum yield of alcohol will be obtained. 45

Dated this 23rd day of April 1895.

WM. P. THOMPSON & Co., 50  
Agents.

Thompson's Process for the Fermentation of Worts which have been Rendered Antiseptic.

## COMPLETE SPECIFICATION.

**An Improved Process for the Fermentation of Worts which have been Rendered Antiseptic.**

A communication by JEAN EFFRONT, of 72, Rue du Marais, Brussels, in the Kingdom of Belgium, Doctor.

I, WILLIAM PHILLIPS THOMPSON, F.C.S., M.I.M.E., of The Agency for Foreign Patent Solicitors, 6, Lord Street, Liverpool, and 6, Bank Street, Manchester, both in the County of Lancaster, 118 New Street, Birmingham, in the County of Warwick, and 31, High Holborn, in the County of Middlesex, Civil Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

The improved process for the fermentation of worts which have been rendered antiseptic, which forms the object of this invention, is characterised by the setting to work in such worts (more particularly in worts for distillery purposes) of yeast which is capable of resisting the action of the antiseptic, and of thus preserving intact its fermenting power.

Hitherto efforts have always been made to overcome the great obstacle to a superior yield of alcohol, namely the existence of ferments of disease in the worts, by eliminating them therefrom, or at least by paralysing them by the aid of certain additions of antiseptics added to the worts in proportions calculated to be more or less favourable to the desired object.

If it be true that this process of rendering the worts antiseptic has the effect of rendering them unchangeable, it is certain on the other hand that the increased yield in alcohol is not very considerable, and that these manifestations so little in accord have given rise to the most erroneous hypotheses, even to that of admitting that another cause than that of the ferments might be the cause of the inferiority in the yield of alcohol.

But it is not so, and it is indeed the disease ferments which alone obstruct the work and diminish the return, and if worts which have been rendered antiseptic do not give the expected superior yield in alcohol, probably by reason of the paralysing of the ferments, it is because it depends on a cause of a very different kind which has hitherto escaped observations made, and which merely consists in the peculiarity that the additions of antiseptics employed for the purpose of paralysing the disease ferments, paralyse at the same time the yeast or fermenting power, which they weaken, thus prejudicing the final yield, and this inconvenience is particularly felt in the case of worts for distillery purposes fermenting relatively at very high temperatures, and consequently the yield of alcohol is not appreciably greater and may even be inferior to that which is obtained if the process be carried out without the use of antiseptics. Even under the most favourable conditions all the benefit which is expected from the use of antiseptics is not obtained, that is to say from the point of view of the yield in alcohol.

Under these conditions it is evident that the solution of the problem is exclusively subordinate to a perfect working of the yeast employed in the worts which have been rendered antiseptic, and that a superior yield of alcohol will be invariably obtained when it is possible to employ for the fermentation a yeast prepared in such a way that its vital force, or its power of fermentation is not affected by wort rendered antiseptic to a given degree, a method of working which constitutes the characteristic of this invention, the extent of which comprises therefore in principle the use of any yeast having a property of vigour or energy.

But in order that the yeast may exercise its vigorous properties, it must be able to necessarily endure an amount of an antiseptic much greater than that of the

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wort which it is intended to ferment, and from this point of view the quantities or proportions of any antiseptics employed in the wort in practice may therefore be reduced to a dose of antiseptics strictly necessary for paralysing the ferments of disease, whereas the yeasts have been accustomed to support quantities much greater by cultivation. 5

The cultivation of the yeast may be effected by means of any suitable antiseptics, such, for instance, as hydrofluoric acid, formic aldehyde, salicylic acid, picric acid, or the like. In order to obtain a sufficiently high antiseptic degree for the yeast, nine phases of cultivation are necessary under the following conditions.

The process will now be described as an example in the treatment of a litre of 10 wort.

The process is as follows when hydro-fluoric acid is employed :—

To one litre of wort of malt or maize there is mixed 10 grammes of beer yeast, and to this mixture .02 grammes of hydrofluoric acid is added and the whole is then left to ferment until the wort which previously weighed 18° Balling has 15 descended to 9° Balling. The yeast is then collected on a filter and it is then introduced afresh into a fresh lot of wort containing .03 grammes of hydrofluoric acid. If after the fresh fermentation this wort has descended from 18° to 9° Balling, a fresh part of the wort containing .04 of hydrofluoric acid is fermented, until it shall also have reached 9° Balling, and this process is continued, increasing 20 at each phase of the ultimate cultivation the proportion of antiseptic by .01 grammes, until the litre of wort in question contains one gramme of hydrofluoric acid.

In order to obtain the same effect with the acid of formic aldehyde, instead of .02 grammes in the first stage, there is employed .04 grammes and this successively until the last stage there are two grammes per litre of formic aldehyde 25 instead of one gramme.

In accordance with the above, if other antiseptics be employed, this treatment is varied conformably with the efficacy of the antiseptic employed whilst the stages in themselves always remain the same.

By this progressive augmentation of the antiseptic, more particularly by 30 commencing with a very small dose, no great delay results in the fermentation, and the passage from one stage or dose to another necessitates from one to eight days.

After the last stage is accomplished, that is to say, with a dose of one gramme of hydrofluoric acid per litre, it is well to renew the wort with the same dose for 35 several weeks.

If then in this operation 3 days are necessary for descending from 18° to 9° Balling the fermentation of the half of the sugar will be effected after some renewals of the wort in 6 to 8 hours. Immediately this effect is obtained, the yeast must be considered as being sufficiently acclimatised to the antiseptic and the process with this object is terminated. 40

The yeast acclimatised in the manner hereinbefore described has special peculiarities. It hardly increases in a wort rendered antiseptic with the maximum dose of antiseptic to which the yeast has been acclimatised. After the fermentation an increase of 5 to 10 cells per 100 cells set in action is found at most. In addition these yeasts are excessively sensitive to any change of medium and of temperature. 45 They will only work, for instance, at a temperature of 30° to 32° C., whilst at 25° fermentation totally ceases.

When conveyed into a malt wort they do not work, and in a maize wort they work very slowly, and in addition they do not keep. By reason of these properties it is not industrially applicable because it is not transportable and so cannot be 50 handled otherwise, and for this reason must be subjected to a special treatment for obviating these drawbacks.

This treatment must therefore be considered as being the second stage in the manufacture of the acclimatised yeast which has been already hereinbefore partially described in a previous Patent, No. 4598, of 1895 and which is 55 characterised by the following process of treatment of the acclimatised yeast according to the process described in the first period.

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This process is based on the circumstance that it has been found that even after desiccation of the yeast hereinbefore described, the latter preserves its fermenting power, and that in this condition not only is it transportable, but also that it may be preserved as desired.

- 5 In order to obtain yeast in this form, special precautions must be employed and special measures taken. The yeast acclimatised in a grain wort containing the maximum of antiseptic in which it can still work is filtered through a paper filter or a filter press. The dregs containing yeast are pressed and moulded into cakes. These cakes are then placed in a stove in which vacuum is produced and in which  
10 a temperature of about  $35^{\circ}$  C. is maintained. After the cakes of yeast have been exposed for 5 or 6 days to this treatment it is ascertained that the yeast has again formed spores. At this moment the temperature of the stove is increased and brought to  $45^{\circ}$  C., always maintaining the vacuum in the stove. After staying there 5 or 6 days in this atmosphere, the cakes of dregs are almost entirely dried,  
15 and these dregs then furnish the very stable active yeast preserving the great fermenting power of the acclimatised yeast, and it is this yeast which is afterwards employed for industrial fermentation. This is done in the following manner:—

- A 100 grammes of these dried dregs are diluted in 10 litres of malt and maize wort, the antiseptic in which the yeast has been acclimatised is added but in a  
20 -lightly smaller dose than that with which the operation was previously performed. For instance if the yeast has been acclimatised in one gramme per litre of hydrofluoric acid  $\cdot 08$  of hydrofluoric acid will be taken for the wort. The wort with the dregs is treated at the temperature of  $30^{\circ}$  C. and the moment of fermentation is awaited. This lasts generally from 2 to 3 days. As soon as the fermentation has  
25 commenced, to the 10 litres of wort in fermentation there are added 40 litres of the same but fresh wort containing the same quantity of antiseptic, then after each period of 24 hours there is added to the wort four times its volume. Thus, for instance, if we have 50 litres of yeasted malt such as has been hereinbefore obtained, there is added at the end of 24 hours  $4 \times 50 = 200$  of fresh wort having  
30  $\cdot 08$  grammes per litre of hydrofluoric acid. The wort is then left from 5 to 6 days to work, the yeast is completely ready, and the wort of  $18^{\circ}$  Balling descends in 24 hours to zero and even below.

- There is thus obtained an industrial yeast for distilleries; and it is sufficient for fermentation in the vats to take two hectolitres of these worts in order to ferment  
35 100 hectolitres.

- It is therefore evident that by means of this system it is in no way necessary (as it has been in the past) to introduce into distilleries enormous quantities of yeast in order to do the necessary work and that on the contrary any desired quantity may be produced or at least enormous quantities of yeast by introducing at the  
40 commencement an insignificant quantity of some 100 grammes. The yeast thus produced by acclimatisation in antiseptics is also much less exacting from the point of view of nutrition than ordinary yeasts, so that it may be applied very advantageously also to the fermentation of molasses. It is well known in fact that in order to ferment molasses with ordinary yeast it has been necessary hitherto to  
45 make yeast containing a very large proportion of grain in order to nourish the yeast, that is to say, that you must have a yeast containing a minimum of 5 *per cent.* of grain, whilst by employing this acclimatised yeast it is hardly necessary to introduce more than a half or a quarter *per cent.*, and, in certain cases, the acclimatised yeast even allows of the grain being totally dispensed with.  
50 It is exactly owing to this use of a large quantity of grain in the fermentation of molasses that hitherto the fermentation has not been as favourable as it ought to be.

- Now with the acclimatised yeast, the question changes entirely, that is to say, if it be desired to ferment fresh molasses it is sufficient in order to commence the  
55 fermentation, to add yeast in very small quantities; but once the fermentation is at work (that is to say, when the molasses antisepticised to the desired degree have been started in fermentation, by a small quantity of yeast, with which is mixed the

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acclimatised yeast, and when the whole mass of molasses has started fermenting) it is sufficient in order to ferment a second vat to take for instance half, or at least a considerable part of a vat in fermentation and to mix it with the part of another vat which is not in fermentation, and to act the same with the latter when the fermentation has reached a maximum degree of fermentation, and so on successively 5 which is called "cutting off" (coupage) by vat.

Having now particularly described and ascertained the nature of the said invention, and in what manner the same is to be performed, as communicated to me by my foreign correspondent, I declare that what I claim is:—

1. A process for the fermentation of worts which have been rendered antiseptic, 10 characterised by the fermentation of such worts by the action of yeast which has been acclimatised so as to be capable of enduring at least double the amount of antiseptic inserted in the wort, such antiseptic being the same as that employed for acclimatising the yeast, substantially as described.

2. In a process such as described, the preparation of yeast acclimatised to anti- 15 septics, characterised by the treatment of worts at 30° Centigrade minimum, with a maximum proportion of 0·2 grammes of antiseptic (HFl) per litre in the first stage of cultivation, increasing it by ·01 at each stage of the subsequent cultivation up to 1 gramme per litre, renewing the wort for each successive stage after it has fallen in the next stage from 18° to 9° Balling and finally by the compression and 20 desiccation under vacuum of the dregs in two operations or stages one at 30° Centigrade, and the second at 45° Centigrade, with the object of imparting to the acclimatised yeast the property of keeping or being preserved substantially as described.

3. In a process such as described, the use instead of HFl of antiseptics having 25 analogous properties, and, conformably to the nature of the latter, the variation of the antiseptic degree of the wort in proportion to the efficacy of the antiseptic, for instance in the case of formic aldehyde from ·02 to ·04 in the first stage, and increasing by ·02 in each successive stage up to 2 grammes per litre substantially 30 as described.

4. The utilisation in distilleries of the herein described dregs yeast by diluting it 35 in the proportion of 100 grammes in 10 litres of wort rendered antiseptic to the extent of ·08, and after fermentation in four times this quantity of a similar wort, (40 litres) and after fermentation by again four times this latter quantity (say 200 litres), then fermenting the whole and afterwards utilising the yeast wort in 35 the vats in the proportion of 2 to 100 hectolitres of wort rendered antiseptic to about half the degree to which the yeast is rendered antiseptic substantially as described.

5. The utilisation of yeast acclimatised according to the process hereinbefore 40 described in a barm containing at most a  $\frac{1}{4}$  or a  $\frac{1}{2}$  per cent. of grain, for the fermentation of molasses-worts and eventually the total suppression of grain, and in the latter case the fermentation of the molasses-worts by blending or mixing two vats, substantially as described.

Dated this 23rd day of January 1896.

WM. P. THOMPSON & Co., 45  
Agents.